

## WHAT IS CLAIMED IS:

1. A deflector which deflects a charged particle beam, comprising:

a substrate having an opening through which the  
5 charged particle beam should pass; and

a deflection electrode which is arranged in the opening to deflect the charged particle beam and has a first conductive member and second conductive member which are formed by plating,

10 wherein said second conductive member is formed on a surface of said first conductive member and is essentially made of a material that is more difficult to oxidize than said first conductive member.

2. The deflector according to claim 1, wherein said  
15 first conductive member is essentially made of a material having a higher plating growth rate than said second conductive member.

3. The deflector according to claim 1, wherein said first conductive member is essentially made of a  
20 material having smaller residual stress than said second conductive member.

4. The deflector according to claim 1, wherein said first conductive member is essentially made of Cu.

5. The deflector according to claim 1, wherein said  
25 second conductive member is essentially made of Au.

6. The deflector according to claim 1, further comprising a third conductive member which covers a

surface of said second conductive member, said third conductive member being essentially made of a material that is more difficult to oxidize than said second conductive member.

5     7.     The deflector according to claim 6, wherein said third conductive member is essentially made of a material having a lower plating growth rate than said second conductive member.

8.     The deflector according to claim 6, wherein said  
10    third conductive member is essentially made of a material having larger residual stress after plating growth than said second conductive member.

9.     A method of manufacturing a deflector which includes a substrate having an opening through which a  
15    charged particle beam should pass, and a deflection electrode which is arranged in the opening to deflect the charged particle beam and has a first conductive member and second conductive member, comprising:

an opening formation step of forming, in the  
20    substrate, an opening to form the deflection electrode;

a first conductive member formation step of forming the first conductive member by plating in the opening formed in the opening formation step; and

a second conductive member formation step of  
25    forming the second conductive member that is more difficult to oxidize than the first conductive member on a surface of the first conductive member by plating.

10. The method according to claim 9, further  
comprising an interconnection layer formation step of  
forming, on a surface of the substrate, an  
interconnection layer electrically connected to the  
5 first conductive member,

wherein the second conductive member formation  
step includes a step of supplying power from the  
interconnection layer to the first conductive member to  
form the second conductive member on the surface of the  
10 first conductive member by electrolytic plating.

11. The method according to claim 9, wherein the  
second conductive member formation step includes a step  
of activating the surface of the first conductive  
member and forming the second conductive member on the  
15 surface of the first conductive member by electroless  
plating.

12. The method according to claim 9, further  
comprising a third conductive member formation step of  
forming a third conductive member that covers the  
20 second conductive member,

wherein the third conductive member is  
essentially made of a material that is more difficult  
to oxidize than the second conductive member.

13. A charged particle beam exposure apparatus which  
25 exposes a wafer by a charged particle beam, comprising:

a charged particle beam generation section which  
generates the charged particle beam; and

a deflector which deflects the charged particle beam to irradiate a desired position on the wafer with the charged particle beam,

wherein said deflector has

5 a substrate having an opening through which the charged particle beam should pass, and

a deflection electrode which is arranged in the opening to deflect the charged particle beam and has a first conductive member and second conductive member

10 which are formed by plating, and

said second conductive member is formed on a surface of said first conductive member and is essentially made of a material that is more difficult to oxidize than said first conductive member.

15 14. A deflector which deflects a charged particle beam, comprising:

a substrate having an opening through which the charged particle beam should pass;

20 a first deflection electrode and second deflection electrode which oppose each other in the opening to deflect the charged particle beam; and

a first conductive layer and second conductive layer which oppose each other in the opening in a direction substantially perpendicular to a direction  
25 from said first deflection electrode to said second deflection electrode and are made of a material having a higher conductivity than said substrate.

15. The deflector according to claim 14, wherein said first conductive layer and said second conductive layer are grounded.

16. The deflector according to claim 14, wherein said  
5 first conductive layer and said second conductive layer are formed by metal plating.

17. The deflector according to claim 14, wherein said first conductive layer and said second conductive layer are thinner than said first deflection electrode and  
10 said second deflection electrode.

18. The deflector according to claim 14, wherein an interval between said first deflection electrode and said second deflection electrode is smaller than an interval between said first conductive layer and said  
15 second conductive layer.

19. The deflector according to claim 14, further comprising a first insulating layer and second insulating layer which are formed between said substrate and said first deflection electrode and  
20 between said substrate and said second deflection electrode, respectively,

wherein said substrate is a silicon substrate,  
and

said first insulating layer and said second  
25 insulating layer are silicon oxide films formed by thermally oxidizing the silicon substrate.

20. The deflector according to claim 14, further

comprising a first insulating layer and second  
insulating layer which are formed between said  
substrate and said first deflection electrode and  
between said substrate and said second deflection  
5 electrode, respectively, and

wherein said first conductive layer and said  
second conductive layer are formed from a position  
adjacent to said first insulating layer to a position  
adjacent to said second insulating layer.

10 21. The deflector according to claim 20, wherein said  
first conductive layer and said second conductive layer  
are formed from an upper end to a lower end of the  
opening not to expose said substrate into the opening.

22. The deflector according to claim 14, wherein in  
15 each of said first deflection electrode and said second  
deflection electrode, an area of a surface that opposes  
another deflection electrode is larger than an area of  
a surface that opposes said substrate.

23. The deflector according to claim 22, wherein each  
20 of said first deflection electrode and said second  
deflection electrode has a trapezoidal columnar shape  
that is gradually tapered along a direction from a  
center of the opening to an inner wall of the opening.

24. The deflector according to claim 14, further  
25 comprising a third insulating layer and fourth  
insulating layer which are formed between said  
substrate and said first conductive layer and between

said substrate and said second conductive layer,  
respectively,

wherein said substrate is a silicon substrate,  
and

5        said third insulating layer and said fourth  
insulating layer are silicon oxide films formed by  
thermally oxidizing the silicon substrate.

25.    A method of manufacturing a deflector which  
includes a substrate having an opening through which a  
10    charged particle beam should pass, a first deflection  
electrode and second deflection electrode which oppose  
each other in the opening so as to deflect the charged  
particle beam, and a first conductive layer and second  
conductive layer which oppose each other in the opening  
15    in a direction substantially perpendicular to a  
direction from the first deflection electrode to the  
second deflection electrode, comprising:

an electrode formation step of forming the first  
deflection electrode and the second deflection  
20    electrode;

an opening formation step of, after the first  
deflection electrode and the second deflection  
electrode are formed in the electrode formation step,  
forming, in the substrate, openings to form the first  
25    conductive layer and the second conductive layer; and

a conductive layer formation step of forming the  
first conductive layer and the second conductive layer

in the plurality of openings formed in the opening formation step.

26. A method of manufacturing a deflector which includes a substrate having an opening through which a charged particle beam should pass, a first deflection electrode and second deflection electrode which oppose each other in the opening to deflect the charged particle beam, a first insulating layer and second insulating layer which are formed between the substrate and the first deflection electrode and between the substrate and the second deflection electrode, a first conductive layer and second conductive layer which oppose each other in the opening in a direction substantially perpendicular to a direction from the first deflection electrode to the second deflection electrode, and a third insulating layer and fourth insulating layer which are formed between the substrate and the first conductive layer and between the substrate and the second conductive layer, comprising:
- an opening formation step of forming, in the substrate, a plurality of openings to form the first deflection electrode, the second deflection electrode, the first conductive layer, and the second conductive layer;
- an insulating layer formation step of forming the first insulating layer, the second insulating layer, the third insulating layer, and the fourth insulating

layer on inner walls of the plurality of openings  
formed in the opening formation step; and

an electrode formation step of forming the first  
deflection electrode, the second deflection electrode,  
5 the first conductive layer, and the second conductive  
layer inside the first insulating layer, the second  
insulating layer, the third insulating layer, and the  
fourth insulating layer in the plurality of openings.

27. The method according to claim 26, wherein the  
10 insulating layer formation step includes a step of  
forming the first insulating layer, the second  
insulating layer, the third insulating layer, and the  
fourth insulating layer by thermally oxidizing the  
inner walls of the plurality of openings.

15 28. A charged particle beam exposure apparatus which  
exposes a wafer by a charged particle beam, comprising:

a charged particle beam generation section which  
generates the charged particle beam; and

a deflector which deflects the charged particle  
20 beam to irradiate a desired position on the wafer with  
the charged particle beam,

wherein said deflector has

a substrate having an opening through which the  
charged particle beam should pass,

25 a first deflection electrode and second  
deflection electrode which oppose each other in the  
opening to deflect the charged particle beam, and

a first conductive layer and second conductive layer which oppose each other in the opening in a direction substantially perpendicular to a direction from said first deflection electrode to said second deflection electrode and are made of a material having a higher conductivity than said substrate.

29. A deflector which deflects a charged particle beam, comprising:

a substrate having a through hole through which the charged particle beam should pass and two groove portions respectively formed on two opposing side surfaces inside the through hole; and

two deflection electrodes which are at least partially buried in the two groove portions,

wherein each of the groove portions has a shape to lock the buried portion of said deflection electrode in the groove portion to prevent said deflection electrode from separating from said substrate.

30. The deflector according to claim 29, wherein in a section substantially perpendicular to a direction of a thickness of said substrate, a maximum width of the buried portion of said deflection electrode in the groove portion is larger than a width of an upper surface of the groove portion.

31. The deflector according to claim 30, wherein the buried portion of said deflection electrode in the groove portion and the groove portion have trapezoidal

columnar shapes, and said deflection electrode engages with the groove portion.

32. The deflector according to claim 29, further comprising an insulating layer between the groove  
5 portion and the buried portion of said deflection electrode in the groove portion,

wherein said substrate is a silicon substrate,  
and

said insulating layer is a silicon oxide film  
10 formed by thermally oxidizing the silicon substrate.

33. A method of manufacturing a deflector which includes a substrate having a through hole through which a charged particle beam should pass and two groove portions respectively formed on two opposing  
15 side surfaces inside the through hole, and two deflection electrodes which are at least partially buried in the two groove portions, comprising:

an opening formation step of forming, in the substrate, openings to form the deflection electrodes  
20 so as to make the groove portions have a shape to lock the buried portion of the deflection electrode in the groove portion to prevent the deflection electrode from separating from the substrate;

an insulating layer formation step of forming an  
25 insulating layer on an inner wall of the opening formed in the opening formation step;

an electrode formation step of forming the

deflection electrode inside the insulating layer;

a step of forming, in the substrate, the through hole through which the charged particle beam should pass; and

5 an insulating layer removal step of removing part of the insulating layer formed in the insulating layer formation step.

34. The method according to claim 33, wherein the opening formation step includes a step of forming, in  
10 the substrate, the openings to form the deflection electrodes, so that in a section substantially perpendicular to a direction of a thickness of the substrate, a maximum width of the buried portion of the deflection electrode in the groove portion becomes  
15 larger than a width of an upper surface of the groove portion.

35. The method according to claim 33, wherein the insulating layer formation step includes a step of forming the insulating layer by thermally oxidizing an  
20 inner wall of the opening.

36. The method according to claim 33, wherein in the insulating layer removal step, part of the insulating layer is removed by wet etching.

37. The method according to claim 33, wherein in the  
25 insulating layer removal step, part of the insulating layer is removed while leaving the insulating layer in the groove portion.

38. A charged particle beam exposure apparatus which exposes a wafer by a charged particle beam, comprising:
- a charged particle beam generation section which generates the charged particle beam; and
  - 5 a deflector which deflects the charged particle beam to irradiate a desired position on the wafer with the charged particle beam,
- wherein said deflector has
- a substrate having a through hole through which
  - 10 the charged particle beam should pass and two groove portions respectively formed on two opposing side surfaces inside the through hole, and
  - two deflection electrodes which are at least partially buried in the two groove portions, and
  - 15 each of the groove portions has a shape to lock the buried portion of said deflection electrode in the groove portion to prevent said deflection electrode from separating from said substrate.